

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2000-2357

(P2000-2357A)

(43) 公開日 平成12年1月7日(2000.1.7)

(51) Int.Cl. ⁷	識別記号	F I	テ-コード(参考)
F 1 6 K 31/06	3 1 0	F 1 6 K 31/06	3 1 0 A 3 G 0 8 4
F 0 2 D 41/20	3 3 0	F 0 2 D 41/20	3 3 0 3 G 3 0 1
45/00	3 1 2	45/00	3 1 2 S 3 H 1 0 6
F 0 2 M 25/08	3 0 1	F 0 2 M 25/08	3 0 1 H

審査請求 未請求 請求項の数4 O L (全 7 頁)

(21) 出願番号 特願平10-170726

(22) 出願日 平成10年6月18日(1998.6.18)

(71) 出願人 000004260

株式会社デンソー

愛知県刈谷市昭和町1丁目1番地

(72) 発明者 樽井 淳

愛知県刈谷市昭和町1丁目1番地 株式会
社デンソー内

(74) 代理人 100098420

弁理士 加古 宗男

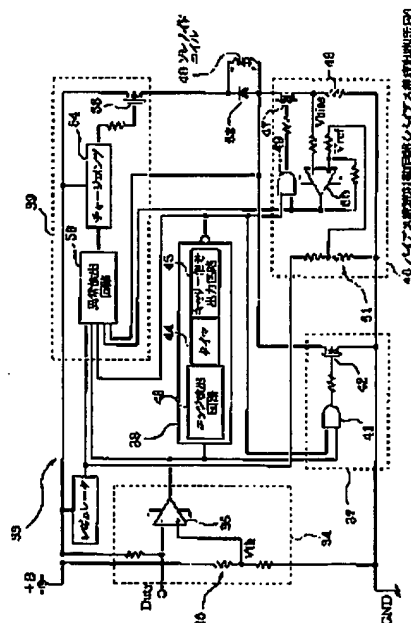
最終頁に続く

(54) 【発明の名称】 電磁弁制御装置

(57) 【要約】

【課題】 電磁弁の開弁制御特性向上と低コスト化とを両立させる。

【解決手段】 バイアス電流制御回路46は、パージ制御弁(電磁弁)のソレノイドコイル40に一定のバイアス電流を流す回路であり、バイアス電流を制御するMOSFET等のスイッチング素子47と電流検出抵抗48との直列回路をデューティ制御用のスイッチング素子42と並列に設ける。バイアス電流制御回路46は、ソレノイドコイル40に流れるバイアス電流を電流検出抵抗48で検出し、スイッチング素子47のスイッチングを制御してバイアス電流を目標値に制御する。ここで、バイアス電流の目標値は、バイアス電流によるパージ制御弁の開弁方向の電磁力が閉弁時のばねによる閉弁力をほぼキャンセルするように設定する。このようにすれば、電源電圧の変動やコイル温度の変化があっても、パージ制御弁の開弁タイミングのずれをほぼ無くすることができる。



(2)

特開2000-2357

1

【特許請求の範囲】

【請求項1】 電磁弁の弁体をばねによって閉弁方向へ付勢し、該電磁弁のソレノイドコイルに電流を流すことで、前記弁体を前記ばねに抗して閉弁方向に駆動して電磁弁の開度を制御する電磁弁制御装置において、前記ソレノイドコイルに所定のバイアス電流を流すバイアス電流制御手段を備えていることを特徴とする電磁弁制御装置。

【請求項2】 前記バイアス電流制御手段は、前記バイアス電流による閉弁方向の電磁力が閉弁時の前記ばねによる閉弁力をほぼキャンセルするように前記バイアス電流を設定することを特徴とする請求項1に記載の電磁弁制御装置。

【請求項3】 前記バイアス電流制御手段は、前記電磁弁の開弁状態が所定時間以上継続した時に前記バイアス電流をオフすることを特徴とする請求項1又は2に記載の電磁弁制御装置。

【請求項4】 前記電磁弁は、燃料タンク内から生じた燃料蒸発ガスを内燃機関の吸気管にバージするバージ経路の途中にバージ制御弁として設けられていることを特徴とする請求項1乃至3のいずれかに記載の電磁弁制御装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、電磁弁の開弁特性を改善した電磁弁制御装置に関するものである。

【0002】

【従来の技術】従来より、電磁弁は、種々の流体の流れを制御する手段として多用されており、例えば、自動車では、燃料蒸発ガスバージシステムのバージ制御弁やアイドルスピードコントロールバルブ（ISC V）等として電磁弁が用いられている。ここで、燃料蒸発ガスバージシステムは、燃料タンク内の燃料が蒸発して生じた燃料蒸発ガス（エボガス）を内燃機関の吸気管にバージするバージ経路の途中に、燃料蒸発ガスを吸着するキャニスタとバージ制御弁とを設け、このバージ制御弁を制御することで、キャニスタから吸気管にバージする燃料蒸発ガスのバージ量を制御するものである。

【0003】現在、使用されているバージ制御弁は、電磁弁を用いた電磁駆動式の他、吸気管負圧を圧力源とするニューマチックバルブを用いた負圧駆動式（特開昭62-153553号公報参照）があるが、負圧駆動式では、吸気管負圧を導入する配管を設ける必要があるため、コスト高になる欠点がある。

【0004】一方、電磁駆動式のバージ制御弁（特開平10-9009号公報参照）は、バージ制御弁の開弁時間（オン時間）と閉弁時間（オフ時間）との比率を制御することで、燃料蒸発ガスのバージ量を制御するようになっている。しかし、バージ制御弁の開弁／閉弁（バージ実行／停止）を頻りに繰り返すと、キャニスタから吸

2

気管に流れ込む燃料蒸発ガスバージ量が脈動するため、内燃機関の気筒内に吸入される混合気の空燃比が乱れて、エミッションやドライバビリティが悪化してしまう。これを改善するために、リニアソレノイドを駆動源とするバージ制御弁を用い、リニアソレノイドへの印加電圧をデューティ制御することで、バージ制御弁の開度を制御して、燃料蒸発ガスのバージ量を制御するようにしたものがある。

【0005】

【発明が解決しようとする課題】ところで、バージ制御弁（電磁弁）には、弁体を閉弁方向へ付勢するばねが内蔵され、このばね力によって閉弁状態が維持されるようになっているため、開弁するには、少なくとも、ばねによる閉弁力に打ち勝つだけの電磁力（開弁力）をソレノイドで発生する必要がある。

【0006】車両運転中は、電源電圧が変動したり、コイル温度の変化によりコイル抵抗値が変化するため、ソレノイドへの印加電圧をデューティ制御する方式では、図4（b）に示すように、電源電圧の変動やコイル温度の変化によりソレノイドコイルに流れる電流値が変化してソレノイドの電磁力が大きく変化してしまい、バージ制御弁が開弁状態から実際に開弁し始める時のデューティ信号DUTYが大きく変化してしまう。

【0007】バージ制御弁の開弁直後に燃料蒸発ガスのバージ量が急増して空燃比を急変させるため、バージ制御弁の開弁と同時に空燃比をバージ量に応じて補正することが好ましいが、従来のデューティ制御方式では、図4（b）に示すように、電源電圧の変動やコイル温度の変化によりバージ制御弁の開弁タイミングが大きくずれてしまうため、エンジン制御回路には実際のバージ制御弁の開弁タイミングが分からず、バージ制御弁の開弁による空燃比の急変を精度良く補正することはできない。

【0008】この不具合を解消するため、近年、ソレノイドコイルに流す電流をフィードバック制御することで、電源電圧の変動やコイル温度の変化の影響を受けないように電磁力（コイル電流値）を制御する電流制御方式のバージ制御弁を採用したものがある。しかし、この電流制御方式では、全領域でコイル電流をフィードバック制御する必要があるため、制御回路の構成が複雑化してコストアップする欠点がある。

【0009】本発明はこのような事情を考慮してなされたものであり、従ってその目的は、電磁弁の開弁制御特性向上と低コスト化とを両立させることができる電磁弁制御装置を提供することにある。

【0010】

【課題を解決するための手段】上記目的を達成するために、本発明の請求項1の電磁弁制御装置は、バイアス電流制御手段によりソレノイドコイルに所定のバイアス電流を流すことで、ばねによる閉弁力に対抗する閉弁方向の電磁力を発生させる。このバイアス電流による閉弁方

(2)

特開2000-2357

1

【特許請求の範囲】

【請求項1】 電磁弁の弁体をばねによって閉弁方向へ付勢し、該電磁弁のソレノイドコイルに電流を流すことで、前記弁体を前記ばねに抗して閉弁方向に駆動して電磁弁の開度を制御する電磁弁制御装置において、前記ソレノイドコイルに所定のバイアス電流を流すバイアス電流制御手段を備えていることを特徴とする電磁弁制御装置。

【請求項2】 前記バイアス電流制御手段は、前記バイアス電流による閉弁方向の電磁力が閉弁時の前記ばねによる閉弁力をほぼキャンセルするように前記バイアス電流を設定することを特徴とする請求項1に記載の電磁弁制御装置。

【請求項3】 前記バイアス電流制御手段は、前記電磁弁の開弁状態が所定時間以上継続した時に前記バイアス電流をオフすることを特徴とする請求項1又は2に記載の電磁弁制御装置。

【請求項4】 前記電磁弁は、燃料タンク内から生じた燃料蒸発ガスを内燃機関の吸気管にバージするバージ経路の途中にバージ制御弁として設けられていることを特徴とする請求項1乃至3のいずれかに記載の電磁弁制御装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、電磁弁の開弁特性を改善した電磁弁制御装置に関するものである。

【0002】

【従来の技術】 従来より、電磁弁は、種々の流体の流れを制御する手段として多用されており、例えば、自動車では、燃料蒸発ガスバージシステムのバージ制御弁やアイドルスピードコントロールバルブ（ISCV）等として電磁弁が用いられている。ここで、燃料蒸発ガスバージシステムは、燃料タンク内の燃料が蒸発して生じた燃料蒸発ガス（エボガス）を内燃機関の吸気管にバージするバージ経路の途中に、燃料蒸発ガスを吸着するキャニスタとバージ制御弁とを設け、このバージ制御弁を制御することで、キャニスタから吸気管にバージする燃料蒸発ガスのバージ量を制御するものである。

【0003】 現在、使用されているバージ制御弁は、電磁弁を用いた電磁駆動式の他、吸気管負圧を圧力源とするニューマチックバルブを用いた負圧駆動式（特開昭62-153553号公報参照）があるが、負圧駆動式では、吸気管負圧を導入する配管を設ける必要があるため、コスト高になる欠点がある。

【0004】 一方、電磁駆動式のバージ制御弁（特開平10-9009号公報参照）は、バージ制御弁の開弁時間（オン時間）と閉弁時間（オフ時間）との比率を制御することで、燃料蒸発ガスのバージ量を制御するようになっている。しかし、バージ制御弁の開弁/閉弁（バージ実行/停止）を頻繁に繰り返すと、キャニスタから吸

2

気管に流れ込む燃料蒸発ガスバージ量が脈動するため、内燃機関の気筒内に吸入される混合気の変換比が乱れて、エミッションやドライバビリティが悪化してしまう。これを改善するために、リニアソレノイドを駆動源とするバージ制御弁を用い、リニアソレノイドへの印加電圧をデューティ制御することで、バージ制御弁の開度を制御して、燃料蒸発ガスのバージ量を制御するようにしたものがある。

【0005】

【発明が解決しようとする課題】 ところで、バージ制御弁（電磁弁）には、弁体を閉弁方向へ付勢するばねが内蔵され、このばね力によって閉弁状態が維持されるようになっているため、開弁するには、少なくとも、ばねによる閉弁力に打ち勝つだけの電磁力（開弁力）をソレノイドで発生する必要がある。

【0006】 車両運転中は、電源電圧が変動したり、コイル温度の変化によりコイル抵抗値が変化するため、ソレノイドへの印加電圧をデューティ制御する方式では、図4（b）に示すように、電源電圧の変動やコイル温度の変化によりソレノイドコイルに流れる電流値が変化してソレノイドの電磁力が大きく変化してしまい、バージ制御弁が開弁状態から実際に開弁し始める時のデューティ信号DUTYが大きく変化してしまう。

【0007】 バージ制御弁の開弁直後に燃料蒸発ガスのバージ量が急増して空燃比を急変させるため、バージ制御弁の開弁と同時に空燃比をバージ量に応じて補正することが好ましいが、従来のデューティ制御方式では、図4（b）に示すように、電源電圧の変動やコイル温度の変化によりバージ制御弁の開弁タイミングが大きくずれてしまうため、エンジン制御回路には実際のバージ制御弁の開弁タイミングが分からず、バージ制御弁の開弁による空燃比の急変を精度良く補正することはできない。

【0008】 この不具合を解消するため、近年、ソレノイドコイルに流す電流をフィードバック制御することで、電源電圧の変動やコイル温度の変化の影響を受けずに電磁力（コイル電流値）を制御する電流制御方式のバージ制御弁を採用したものがある。しかし、この電流制御方式では、全領域でコイル電流をフィードバック制御する必要があるため、制御回路の構成が複雑化してコストアップする欠点がある。

【0009】 本発明はこのような事情を考慮してなされたものであり、従ってその目的は、電磁弁の開弁制御特性向上と低コスト化とを両立させることができる電磁弁制御装置を提供することにある。

【0010】

【課題を解決するための手段】 上記目的を達成するために、本発明の請求項1の電磁弁制御装置は、バイアス電流制御手段によりソレノイドコイルに所定のバイアス電流を流すことで、ばねによる閉弁力に対抗する開弁方向の電磁力を発生させる。このバイアス電流による開弁方

(3)

特開2000-2357

3

向の電磁力がばねによる閉弁力に近付くほど、電磁弁の開弁タイミングのずれが少なくなる(図4参照)。従って、バイアス電流を流しながらデューティ制御を行えば、従来のデューティ制御よりも電磁弁の開度を精度良く制御できる。しかも、電流制御方式とは異なり、全領域でコイル電流をフィードバック制御する必要がなく、簡単な回路構成を採用することができる。

【0011】この場合、請求項2のように、バイアス電流による開弁方向の電磁力が開弁時のばねによる閉弁力をほぼキャンセルするようにバイアス電流を設定することが好ましい。このようにすれば、電源電圧の変動やコイル温度の変化があっても、電磁弁の開弁タイミングのずれをほぼ無くすることができる。

【0012】また、請求項3のように、電磁弁の開弁状態が所定時間以上継続した時にバイアス電流をオフするようにしても良い。つまり、電磁弁の開弁状態が長く続く時には、バイアス電流を流す必要がないため、バイアス電流をオフすれば、電磁弁の開弁中のバイアス電流による消費電力増加やコイル温度上昇を回避できると共に、ばねによる閉弁力を確実に働かせて電磁弁を開弁状態に確実に保持することができる。

【0013】以上説明した本発明の電磁弁制御装置は、種々の流体の流れを電磁弁で制御するシステムに適用可能であるが、特に、請求項4のように、燃料蒸発ガスバージンシステムに適用すれば、大きな効果が得られる。つまり、バージ制御弁の開弁直後に燃料蒸発ガスのバージ量が急増して空燃比を急激に悪化させるため、バージ制御弁の開弁と同時に空燃比をバージ量に応じて補正することが好ましい。本発明の電磁弁制御装置は、従来のデューティ制御方式と比較して、開弁タイミングのずれが少ない(又はゼロ)であるため、バージ制御弁の開弁による空燃比の急変を精度良く補正することが可能となり、バージ制御時のエミッションやドライバビリティを改善することができる。

【0014】

【発明の実施の形態】以下、本発明を燃料蒸発ガスバージンシステムに適用した一実施形態を図面に基づいて説明する。まず、図3に基づいてシステム全体の概略構成を説明する。エンジン11の吸気管12の上流側にはエアクリーナ13が設けられ、このエアクリーナ13を通過した空気がスロットルバルブ14を通してエンジン11の各気筒に吸入される。また、吸気管12の各気筒の吸気ポートには燃料噴射弁16が設けられ、各燃料噴射弁16には、燃料タンク17内の燃料(ガソリン)が燃料ポンプ18により燃料配管19を介して送られてくる。

【0015】次に、燃料蒸発ガスバージンシステム21の構成を説明する。燃料タンク17には、連通管22を介してキャニスタ23が接続され、このキャニスタ23内に収容された活性炭等の吸着体24によって燃料蒸発ガスが吸着される。このキャニスタ23の底面には、大

4

気に連通する大気連通管25が設けられ、この大気連通管25にキャニスタ閉塞弁26が取り付けられている。このキャニスタ閉塞弁26は、常閉型の電磁弁により構成され、バージ制御中は、オフ状態(閉弁状態)に維持され、キャニスタ23内が大気に開放された状態に保持される。

【0016】一方、キャニスタ23と吸気管12の間には、吸着体24に吸着された燃料蒸発ガスを吸気管12にバージ(放出)するためのバージ通路30a、30bが設けられ、このバージ通路30a、30b間に、バージ流量を調整するバージ制御弁31が設けられている。このバージ制御弁31は、常閉型の電磁弁により構成され、オフ時には、内蔵したばね(図示せず)によって閉弁状態に保持される。このバージ制御弁31は、エンジン制御回路32内に設けられたマイクロコンピュータ(図示せず)とバージ制御回路33(図1参照)とによって制御される。エンジン制御回路32内のマイクロコンピュータは、エンジン運転状態に応じてバージ制御弁31の目標開度(目標バージ率)を演算し、その目標開度に応じたデューティ信号Dutyをバージ制御回路33に出力する。

【0017】次に、図1に基づいてバージ制御回路33の構成を説明する。バージ制御回路33の入力インターフェース回路34には、コンパレータ35が内蔵されている。このコンパレータ35の入力端子には、エンジン制御回路32内のマイクロコンピュータから出力されるデューティ信号Dutyが入力され、該コンパレータ35の+入力端子には、分圧回路36の抵抗比で分圧された基準電圧Vthが入力される。コンパレータ35は、デューティ信号Dutyと基準電圧Vthとを比較し、図2に示すようにデューティ信号Dutyがハイレベル(Duty > Vth)の時に、該コンパレータ35の出力がローレベルとなり、デューティ信号Dutyがローレベル(Duty < Vth)の時に、該コンパレータ35の出力がハイレベルとなる。

【0018】このコンパレータ35の出力(デューティ信号Dutyを反転した信号)は、デューティ制御回路37、バイアス電流オン/オフ回路38及びフェールセーフ回路39にそれぞれ入力される。デューティ制御回路37は、バージ制御弁31のソレノイドコイル40への通電をデューティ制御する回路であり、AND回路41と、このAND回路41の出力によって駆動されるMOSFET等のスイッチング素子42とから構成されている。AND回路41の両入力端子には、コンパレータ35の出力とバイアス電流オン/オフ回路38の出力とが入力され、両入力共にハイレベルの時のみ、AND回路41の出力がハイレベルに反転して、デューティ制御用のスイッチング素子42がオンする。このスイッチング素子42は、ソレノイドコイル40の通電回路中に設けられているため、スイッチング素子42がオンする

(4)

特開2000-2357

5

と、ソレノイドコイル40に電流が流れる。

【0019】バイアス電流オン/オフ回路38は、パー
ジ制御弁31の開弁状態が一定時間Td以上継続した時
にソレノイドコイル40のバイアス電流をオフする回路
であり、コンパレータ35の出力の立上がり、立下がり
のエッジを検出するエッジ検出回路43、タイマ44及
びキャリア信号出力回路45等から構成されている。エ
ッジ検出回路43は、コンパレータ35の出力の立上がり、
立下がりのいずれかのエッジを検出した時に、タイ
マ44をクリアする。このタイマ44は、クリア後の経
過時間をカウントし、そのカウント値が一定時間Td
(デューティ信号Dutyの周期の少なくとも数倍以上
の時間)に達した時、つまりコンパレータ35の出力の
立上がり/立下がりエッジが検出されない状態(パー
ジ制御弁31の開弁状態)が一定時間Tdに達した時に、
キャリア信号出力回路45からキャリア信号が出力さ
れ、このキャリア信号によってバイアス電流オン/オフ
回路38の出力がローレベルに反転する。このローレ
ベル信号は、デューティ制御回路37と後述するバイアス
電流制御回路46にそれぞれ入力され、双方の動作が禁
止された状態となる。これにより、ソレノイドコイル4
0のバイアス電流がオフされる。

【0020】バイアス電流のオフ後、エッジ検出回路4
3でコンパレータ35の出力の立上がり、立下がりのい
ずれかのエッジが検出されれば、その時点で、バイアス
電流オン/オフ回路38の出力がハイレベルに反転し、
デューティ制御回路37及びバイアス電流制御回路46
の動作が許可された状態となる。これにより、ソレノ
イドコイル40に再び、バイアス電流が流れる。

【0021】バイアス電流制御回路46は、ソレノイド
コイル40に一定のバイアス電流を流す回路であり、バ
イアス電流を制御するMOSFET等のスイッチング素
子47と電流検出抵抗48との直列回路が上述したデュー
ティ制御用のスイッチング素子42と並列に設けられ
ている。ソレノイドコイル40に流れるバイアス電流
は、バイアス電流制御用のスイッチング素子47を介し
て電流検出抵抗48に流れ、この電流検出抵抗48にバ
イアス電流に応じた電圧Vbiasが発生する。この電圧V
biasは、コンパレータ50の-入力端子に入力され、該
コンパレータ50の+入力端子には、分圧回路51の抵
抗比で分圧されたバイアス電流設定用の基準電圧Vref
が入力される。コンパレータ50は、バイアス電流検出
電圧Vbiasと基準電圧Vrefとを比較し、その比較結果
に応じて出力をハイレベル/ローレベルに切り換える。
このコンパレータ50の出力は、AND回路49の一方
の入力端子に入力され、該AND回路49の他方の入力
端子には、バイアス電流オン/オフ回路38の出力が入
力される。このAND回路49の出力によってスイッ
チング素子47が駆動され、ソレノイドコイル40に一定
のバイアス電流が流れる。

6

【0022】デューティ制御中(パージ制御中)は、A
ND回路49の一方の入力(バイアス電流オン/オフ回
路38の出力)がハイレベルに維持されるため、AND
回路49の出力レベルは、他方の入力端子に入力される
コンパレータ50の出力に応じて切り換えられる。これ
により、ソレノイドコイル40に流れるバイアス電流が
基準電圧Vrefで設定した目標値となるようにバイアス
電流制御用のスイッチング素子47のオン/オフが制御
される。この場合、バイアス電流によるパージ制御弁3
1の開弁方向の電磁力が開弁時のばねによる閉弁力をほ
ぼキャンセルするようにバイアス電流の目標値(基準電
圧Vref)が設定されている。以上説明したバイアス電
流制御回路46及びバイアス電流オン/オフ回路38
は、特許請求の範囲でいうバイアス電流制御手段として
機能する。

【0023】一方、フェールセーフ回路39は、パージ
制御回路33の異常を検出する異常検出回路53と、電
源電圧(+B)を昇圧するチャージポンプ54と、この
チャージポンプ54によって駆動されるMOSFET等
のスイッチング素子55とから構成され、ソレノイドコ
イル40の通電回路中にスイッチング素子55が接続さ
れている。パージ制御回路33が正常に動作している時
には、異常検出回路53からチャージポンプ54に駆動
信号が出力されて、チャージポンプ54が駆動され、ス
イッチング素子55がオン状態に保持される。そして、
異常検出回路53がパージ制御回路33の異常を検出す
ると、チャージポンプ54の駆動が停止され、スイッ
チング素子55がオフしてソレノイドコイル40への通電
が遮断される。尚、ソレノイドコイル40には、サージ
吸収用のダイオード52が並列に接続されている。

【0024】以上説明した実施形態では、バイアス電流
制御回路46によりパージ制御弁31のソレノイドコイ
ル40に一定のバイアス電流を流すと共に、バイアス電
流による開弁方向の電磁力が開弁時のばねによる閉弁力
をほぼキャンセルするようにバイアス電流を制御するの
で、図4(a)に示すように、電源電圧の変動やコイル
温度の変化によって電磁力(開弁力)が変化した場合とし
ても、パージ制御弁31の開弁タイミングのずれをほぼ無
くすることができる。このため、デューティ信号Duty
からパージ制御弁31の開弁タイミングを判断してパー
ジ制御による空燃比の変動を補正しても、この空燃比補
正を従来[図4(b)参照]よりも精度良く行うことが
可能となり、パージ制御時のエミッションやドライバビ
リティを改善することができる。しかも、電流制御方式
とは異なり、全領域でコイル電流をフィードバック制御
する必要がなく、簡単な回路構成を採用することがで
き、低コスト化の要求を満たすことができる。

【0025】尚、上記実施形態では、バイアス電流によ
る開弁方向の電磁力が開弁時のばねによる閉弁力をほ
ぼキャンセルするように設定したが、バイアス電流による

(5)

特開2000-2357

7

開弁方向の電磁力を開弁時のばねによる開弁力の例えば90%、80%、70%、…等のいずれかに設定しても良い。図4から明らかなように、バイアス電流による開弁方向の電磁力がばねによる開弁力に近付くほど、電磁弁の開弁タイミングのずれが少なくなる。従って、バイアス電流による開弁方向の電磁力が開弁時のばねによる開弁力よりも小さい場合でも、従来〔図4（b）参照〕と比較すれば、開弁タイミングのずれを少なくすることができ、パージ制御弁31の開弁特性を向上させることができる。

【0026】また、上記実施形態では、パージ制御弁31の開弁状態が一定時間Td以上継続した時に、バイアス電流オン/オフ回路38によりソレノイドコイル40のバイアス電流をオフするようにしたので、パージ制御弁31の開弁中のバイアス電流による消費電力増加やコイル温度上昇を回避できると共に、ばねによる開弁力を確実に働かせてパージ制御弁31を開弁状態に確実に保持することができる。

【0027】尚、上記実施形態では、バイアス電流が一旦オフされると、その後、コンパレータ35の出力（デューティ信号Dutyを反転した信号）の立上がり/立下がりエッジが検出されるまで、バイアス電流がオフされた状態が続くようになっているが、例えば、バイアス電流がオフされている時には、エンジン制御回路32内のマイクロコンピュータからデューティ信号Dutyを出力する前に、バイアス電流通電再開用のパルスを出し、このパルスによってバイアス電流オン/オフ回路38の出力をハイレベルに反転させてバイアス電流の通電を再開した後にデューティ信号Dutyを出力するようにしても良い。

【0028】また、上記実施形態では、ソレノイドコイル40によるサージ電圧を吸収する手段としてダイオード52を用いたが、これに代えて、ツェナーダイオード

8

やCR回路等を使用したサージ吸収回路を用いても良い。また、スイッチング素子42、47、55は、MOSFETに代えて、バイポーラトランジスタ、IGBT、サイリスタ等の他のスイッチング素子を使用しても良い。

【0029】その他、本発明は、パージ制御弁の制御装置に限定されず、例えばアイドルスピードコントロールバルブ（ISCV）等、自動車に使用される各種の電磁弁や、自動車以外に使用される各種の電磁弁の制御装置にも適用可能である。

【図面の簡単な説明】

【図1】本発明を燃料蒸発ガスパージシステムに適用した一実施形態におけるパージ制御回路の構成を示す回路図

【図2】パージ制御回路の各部の電圧波形を示すタイムチャート

【図3】燃料蒸発ガスパージシステムの構成を概略的に示す図

【図4】（a）は本発明の実施形態におけるパージ制御弁の開弁特性を示す図、（b）は従来のパージ制御弁の開弁特性を示す図

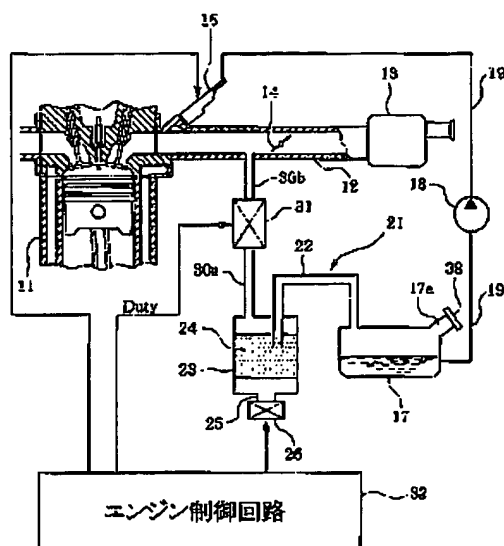
【符号の説明】

1…吸気管、17…燃料タンク、21…燃料蒸発ガスパージシステム、23…キャニスタ、24…吸着体、26…キャニスタ閉塞弁、30a、30b…パージ通路、31…パージ制御弁（電磁弁）、32…エンジン制御回路、33…パージ制御回路、37…デューティ制御回路、38…バイアス電流オン/オフ回路（バイアス電流制御手段）、39…フェールセーフ回路、40…ソレノイドコイル、42…スイッチング素子、46…バイアス電流制御回路（バイアス電流制御手段）、47…スイッチング素子、48…電流検出抵抗、53…異常検出回路、55…スイッチング素子。

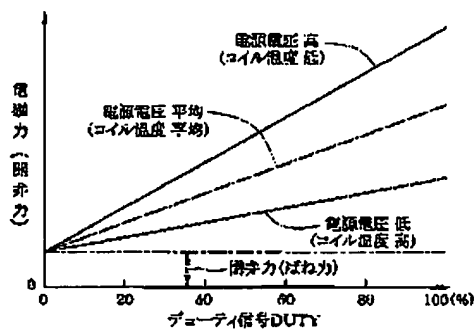
(7)

特開2000-2357

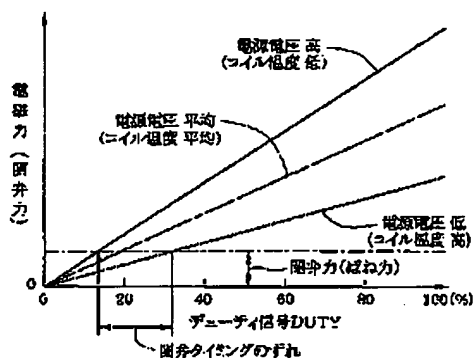
【図3】



【図4】



(a) 本発明の実施形態



(b) 従来のデューティ制御

フロントページの続き

F ターム(参考) 3G084 BA06 BA27 DA04 DA13 EA07
 EG01 EG03 EG06 FA00
 3G301 HA01 HA14 JA14 LA04 MA11
 NB03 NC02 NE23 PB09Z
 PG02Z
 3H106 EE01 EE48 FA02 FB08 FB43
 GA30 KK17

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-002357

(43)Date of publication of application : 07.01.2000

(51)Int.Cl.

F16K 31/06
F02D 41/20
F02D 45/00
F02M 25/08

(21)Application number : 10-170726

(71)Applicant : DENSO CORP

(22)Date of filing : 18.06.1998

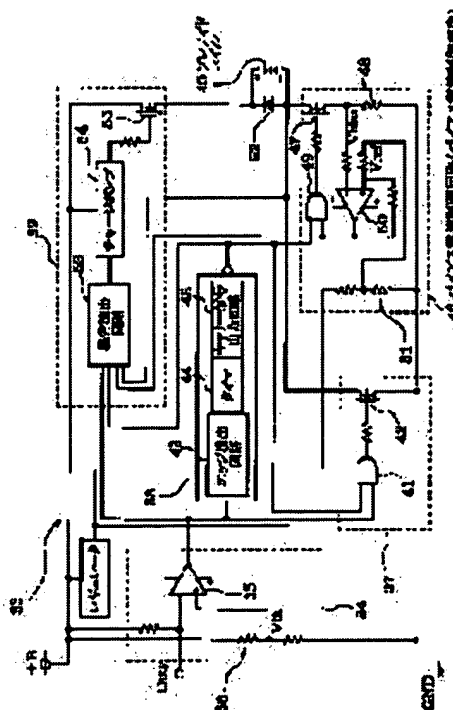
(72)Inventor : TARUI ATSUSHI

(54) SOLENOID VALVE CONTROL DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance the valve opening control characteristics of a solenoid valve compatibly with achievement of low cost.

SOLUTION: A bias current control circuit 46 is the one for feeding a definite bias current to a solenoid coil 40 of a purge control valve (solenoid operated), in which a series circuitry of a switching element 47 such as MOSFET for control of the bias current and a current sensing resistance 48 is installed parallel with a switching element 42 for duty control. The bias current flowing in the solenoid coil 40 is detected by the resistance 48, and the control circuit 46 controls the operation of the switching element 47 so that the bias current becomes identical to the target. The target for the bias current is set so that the valve closing force of a spring at the time of valve closing is canceled substantially by the electromagnetic force in opening direction of the purge control valve based on the bias current. This enables to eliminate substantially a dislocation of the opening timing of the purge control valve even though a variation exists in the source voltage and/or coil temperature.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The solenoid-valve control device characterized by having the bias current control means which passes a predetermined bias current to said solenoid coil in the solenoid-valve control device which energizes the valve element of a solenoid valve in the direction of clausilium with a spring, resists said spring, drives said valve element in the valve-opening direction by passing a current to the solenoid coil of this solenoid valve, and controls the opening of a solenoid valve.

[Claim 2] Said bias current control means is a solenoid-valve control unit according to claim 1 characterized by setting up said bias current so that the electromagnetic force of the valve-opening direction by said bias current may cancel mostly the clausilium force with said spring at the time of clausilium.

[Claim 3] Said bias current control means is a solenoid-valve control unit according to claim 1 or 2 characterized by turning off said bias current when the clausilium condition of said solenoid valve continues beyond predetermined time.

[Claim 4] Said solenoid valve is a solenoid-valve control unit according to claim 1 to 3 characterized by being prepared as a purge control valve in the middle of the purge path which purges the evaporative gas produced from the inside of a fuel tank to an internal combustion engine's inlet pipe.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the solenoid-valve control unit which has improved the valve-opening property of a solenoid valve.

[0002]

[Description of the Prior Art] Conventionally, the solenoid valve is used abundantly as a means to control the flow of various fluids, for example, the solenoid valve is used by automobile as a purge control valve, an idle speed control valve (ISCV), etc. of an evaporative gas purge system. The canister which adsorbs evaporative gas in the middle of and a purge control valve are prepared, it is controlling this purge control valve, and the amount of purges of the evaporative gas purged from a canister to an inlet pipe is controlled. [the purge path which purges the evaporative gas (evaporated gas) with which the fuel in a fuel tank evaporated and produced the evaporative gas purge system here to an internal combustion engine's inlet pipe]

[0003] the electromagnetism for which current and the purge control valve currently used used the solenoid valve -- although there is a negative pressure drive type (refer to JP,62-153553,A) using the pneumatic bulb which makes a pressure source inlet-pipe negative pressure besides a drive type, since it is necessary to prepare piping which introduces inlet-pipe negative pressure, there is a fault which becomes cost quantity by the negative pressure drive formula.

[0004] on the other hand -- electromagnetism -- the purge control valve (refer to JP,10-9009,A) of a drive type controls the amount of purges of evaporative gas by controlling the ratio of the valve-opening time amount (ON time amount) of a purge control valve, and clausilium time amount (off time amount). However, if valve opening/clausilium of a purge control valve (purge activation / halt) are repeated frequently, since the amount of evaporative gas purges which flows into an inlet pipe from a canister will pulsate, the air-fuel ratio of the gaseous mixture inhaled in an internal combustion engine's gas column will be confused, and emission and drivability will get worse. In order to improve this, there are some which control the opening of a purge control valve by carrying out duty control of the applied voltage to a linear solenoid, and controlled the amount of purges of evaporative gas by it using the purge control valve which makes a linear solenoid a driving source.

[0005]

[Problem(s) to be Solved by the Invention] By the way, since the spring which energizes a valve element in the direction of clausilium is built in a purge control valve (solenoid valve) and a clausilium condition is maintained according to this spring force, in order to open, it is necessary to generate at least only the electromagnetic force (valve-opening force) which overcomes the clausilium force with a spring in a solenoid.

[0006] During car operation, since supply voltage is changed or coil resistance changes with change of coil temperature, as the applied voltage to a solenoid shown to drawing 4 (b) in the method which carries out duty control, the current value which flows to a solenoid coil by fluctuation of supply voltage or change of coil temperature will change, the electromagnetic force of a solenoid will change a lot, and

the duty signal DUTY in case a purge control valve actually begins to open from a clausilium condition will change a lot.

[0007] In order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, Although it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve, in the conventional duty control system Since the valve-opening timing of a purge control valve shifts greatly by fluctuation of supply voltage, or change of coil temperature as shown in drawing 4 (b), An engine control circuit cannot understand valve-opening timing of an actual purge control valve, and sudden change of the air-fuel ratio by valve opening of a purge control valve cannot be amended with a sufficient precision.

[0008] In order to cancel this fault, there are some which adopted the purge control valve of the current control system which controls electromagnetic force (coil current value) by carrying out feedback control of the current passed to a solenoid coil in recent years not to be influenced [fluctuation of supply voltage or] by coil temperature of change. However, in this current control system, since it is necessary to carry out feedback control of the coil current in all fields, the configuration of a control circuit is complicated and there is a fault which carries out a cost rise.

[0009] This invention is made in consideration of such a situation, therefore the purpose is in offering the solenoid-valve control unit which can reconcile the improvement in the valve-opening control characteristic and low-cost-izing of a solenoid valve.

[0010]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the solenoid-valve control device of claim 1 of this invention is passing a predetermined bias current to a solenoid coil by the bias current control means, and generates the electromagnetic force of the valve-opening direction which opposes the clausilium force with a spring. A gap of the valve-opening timing of a solenoid valve decreases, so that the electromagnetic force of the valve-opening direction by this bias current approaches the clausilium force with a spring (refer to drawing 4). Therefore, if duty control is performed for a bias current with a sink, the opening of a solenoid valve is controllable with a sufficient precision from the conventional duty control. And it is not necessary to carry out feedback control of the coil current in all fields, and, unlike a current control system, easy circuitry can be adopted.

[0011] In this case, it is desirable to set up a bias current like claim 2, so that the electromagnetic force of the valve-opening direction by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. If it does in this way, even if there are fluctuation of supply voltage and change of coil temperature, a gap of the valve-opening timing of a solenoid valve can be lost mostly.

[0012] Moreover, when the clausilium condition of a solenoid valve continues beyond predetermined time, you may make it turn off a bias current like claim 3. That is, while being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of a solenoid valve if a bias current is turned off since it is not necessary to pass a bias current when the clausilium condition of a solenoid valve continues for a long time, the clausilium force with a spring can be used certainly and a solenoid valve can be certainly held in the clausilium condition.

[0013] Although the solenoid-valve control unit of this invention explained above can apply the flow of various fluids to the system controlled by the solenoid valve, if it applies to an evaporative gas purge system, big effectiveness will be especially acquired like claim 4. That is, in order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve. Since a gap of valve-opening timing is few (or zero) as compared with the conventional duty control system, the solenoid-valve control device of this invention becomes possible [amending sudden change of the air-fuel ratio by valve opening of a purge control valve with a sufficient precision], and can improve the emission and drivability at the time of purge control.

[0014]

[Embodiment of the Invention] Hereafter, 1 operation gestalt which applied this invention to the

evaporative gas purge system is explained based on a drawing. First, the outline configuration of the whole system is explained based on drawing 3. An air cleaner 13 is formed in the upstream of the inlet pipe 12 of an engine 11, and the air which passed this air cleaner 13 is inhaled by each gas column of an engine 11 through a throttle valve 14. Moreover, a fuel injection valve 16 is formed in the suction port of each gas column of an inlet pipe 12, and the fuel in a fuel tank 17 (gasoline) is sent to each fuel injection valve 16 through a fuel line 19 by the fuel pump 18.

[0015] Next, the configuration of the evaporative gas purge system 21 is explained. A canister 23 is connected to a fuel tank 17 through the communicating tube 22, and it is adsorbed by adsorbent 24, such as activated carbon held in this canister 23, in evaporative gas. The atmospheric-air communicating tube 25 which is open for free passage to atmospheric air is formed in the bottom surface part of this canister 23, and the canister lock out valve 26 is attached in this atmospheric-air communicating tube 25. This canister lock out valve 26 is constituted by the solenoid valve of a normally open mold, during purge control, is maintained by the OFF state (valve-opening condition), and is held at the condition that the inside of a canister 23 was wide opened by atmospheric air.

[0016] On the other hand, between a canister 23 and an inlet pipe 12, the purge paths 30a and 30b for purging the evaporative gas with which adsorbent 24 was adsorbed to an inlet pipe 12 (emission) are formed, and the purge control valve 31 which adjusts a purge flow rate between this purge path 30a and 30b is formed in it. This purge control valve 31 is constituted by the solenoid valve of a normally closed mold, and is held in the clausilium condition with the built-in spring (not shown) at the time of OFF.

This purge control valve 31 is controlled by the microcomputer (not shown) and the purge control circuit 33 (refer to drawing 1) which were prepared in the engine control circuit 32. The microcomputer in the engine control circuit 32 calculates the target opening (rate of a target purge) of the purge control valve 31 according to an engine operation condition, and outputs the duty signal Duty according to the target opening to the purge control circuit 33.

[0017] Next, the configuration of the purge control circuit 33 is explained based on drawing 1. The comparator 35 is built in the input interface circuitry 34 of the purge control circuit 33. The duty signal Duty outputted from the microcomputer in the engine control circuit 32 is inputted into - input terminal of this comparator 35, and the reference voltage V_{th} by which the partial pressure was carried out by the resistance ratio of the partial pressure circuit 36 is inputted into + input terminal of this comparator 35. The duty signal Duty is compared with reference voltage V_{th} , as shown in drawing 2, when the duty signal Duty is high level ($Duty > V_{th}$), the output of this comparator 35 serves as a low level, and when the duty signal Duty is a low level ($Duty < V_{th}$), it becomes high-level outputting [of this comparator 35] a comparator 35.

[0018] The output (signal which reversed the duty signal Duty) of this comparator 35 is inputted into the duty control circuit 37, the bias current ON / off circuit 38, and the fail-safe circuit 39, respectively. The duty control circuit 37 is a circuit which carries out duty control of the energization to the solenoid coil 40 of the purge control valve 31, and consists of AND circuit 41 and switching elements 42, such as MOSFET driven with the output of this AND circuit 41. The output of a comparator 35 and the output of bias current ON / OFF circuit 38 are inputted into both the input terminals of AND circuit 41, only when both inputs of both are high-level, the output of AND circuit 41 is reversed high-level, and the switching element 42 for duty control turns on. Since this switching element 42 is formed all over the energization circuit of a solenoid coil 40, if a switching element 42 turns on, a current will flow to a solenoid coil 40.

[0019] For bias current ON / off circuit 38, the clausilium condition of the purge control valve 31 is fixed time amount T_d . When it continues above, it is the circuit which turns off the bias current of a solenoid coil 40, and it consists of the edge detectors 43, the timers 44, and carry signal output circuit 45 grades which detect the start of the output of a comparator 35, and the edge of a fall. The edge detector 43 clears a timer 44, when the edge of the start of the output of a comparator 35 and either of the falls is detected. When this timer 44 counts the elapsed time after clear and that counted value reaches fixed time amount T_d (time amount of at least several times or more of the period of the duty signal Duty), That is, the condition (clausilium condition of the purge control valve 31) that the start / fall edge of the

output of a comparator 35 are not detected is fixed time amount T_d . When it reaches A carry signal is outputted from the carry signal output circuit 45, and the output of bias current ON / off circuit 38 is reversed to a low level with this carry signal. This low-level signal is inputted into the duty control circuit 37 and the bias current control circuit 46 mentioned later, respectively, and will be in the condition that actuation of both sides was forbidden. Thereby, the bias current of a solenoid coil 40 is turned off.

[0020] If the edge of the start of the output of a comparator 35 and either of the falls is detected after [of a bias current] off, and in the edge detector 43, at the time, the output of bias current ON / off circuit 38 is reversed high-level, and it will be in the condition that actuation of the duty control circuit 37 and the bias current control circuit 46 was permitted. Thereby, a bias current flows again to a solenoid coil 40.

[0021] The bias current control circuit 46 is a circuit which passes a fixed bias current to a solenoid coil 40, and is established in the switching element 42 for duty control and juxtaposition which the series circuit of the switching elements 47, such as MOSFET which controls a bias current, and the current detection resistance 48 mentioned above. The bias current which flows to a solenoid coil 40 flows to the current detection resistance 48 through the switching element 47 for bias current control, and the electrical potential difference V_{bias} according to a bias current generates it in this current detection resistance 48. This electrical potential difference V_{bias} is the reference voltage V_{ref} for a bias current setup by which was inputted into - input terminal of a comparator 50, and the partial pressure was carried out to + input terminal of this comparator 50 by the resistance ratio of the partial pressure circuit 51. It is inputted. A comparator 50 is the bias current detection electrical potential difference V_{bias} and reference voltage V_{ref} . It compares and an output is switched to high level/low level according to the comparison result. The output of this comparator 50 is inputted into one input terminal of AND circuit 49, and the output of bias current ON / off circuit 38 is inputted into the input terminal of another side of this AND circuit 49. With the output of this AND circuit 49, a switching element 47 drives and a fixed bias current is passed by the solenoid coil 40.

[0022] During duty control (under purge control), since one input (output of bias current ON / off circuit 38) of AND circuit 49 is maintained high-level, the output level of AND circuit 49 is switched according to the output of the comparator 50 inputted into the input terminal of another side. Thereby, the bias current which flows to a solenoid coil 40 is reference voltage V_{ref} . ON/OFF of the switching element 47 for bias current control are controlled to become the set-up desired value. In this case, the desired value (reference voltage V_{ref}) of a bias current is set up so that the electromagnetic force of the valve-opening direction of the purge control valve 31 by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. The bias current control circuit 46, and the bias current ON / off circuit 38 explained above functions as a bias current control means as used in the field of a claim.

[0023] On the other hand, the fail-safe circuit 39 consists of a malfunction detection circuit 53 which detects the abnormalities of the purge control circuit 33, a charge pump 54 which carries out the pressure up of the supply voltage (+B), and switching elements 55, such as MOSFET driven with this charge pump 54, and the switching element 55 is connected all over the energization circuit of a solenoid coil 40. While the purge control circuit 33 is operating normally, a driving signal is outputted to the charge pump 54 from the malfunction detection circuit 53, the charge pump 54 drives, and a switching element 55 is held at an ON state. And if the malfunction detection circuit 53 detects the abnormalities of the purge control circuit 33, the drive of the charge pump 54 will be stopped, a switching element 55 will turn off, and the energization to a solenoid coil 40 will be intercepted. In addition, the diode 52 for surge absorption is connected to the solenoid coil 40 at juxtaposition.

[0024] With the operation gestalt explained above, while passing a fixed bias current to the solenoid coil 40 of the purge control valve 31 by the bias current control circuit 46 Since a bias current is controlled so that the electromagnetic force of the valve-opening direction by the bias current cancels mostly the clausilium force with the spring at the time of clausilium As shown in drawing 4 (a), even if electromagnetic force (valve-opening force) changes with fluctuation of supply voltage, or change of coil temperature, a gap of the valve-opening timing of the purge control valve 31 can be lost mostly. For

this reason, even if it judges the valve-opening timing of the purge control valve 31 from the duty signal Duty and amends fluctuation of the air-fuel ratio by purge control, it becomes possible to perform this air-fuel ratio amendment with a precision more sufficient than [referring to drawing 4 (b)] conventionally, and the emission and drivability at the time of purge control can be improved. And it is not necessary to carry out feedback control of the coil current in all fields, unlike a current control system, easy circuitry can be adopted, and the demand of low-cost-izing can be filled.

[0025] In addition, although it set up with the above-mentioned operation gestalt so that the electromagnetic force of the valve-opening direction by the bias current might cancel mostly the clausilium force with the spring at the time of clausilium, the electromagnetic force of the valve-opening direction by the bias current may be set as either, such as --, the clausilium force with the spring at the time of clausilium, for example, 90%, 80%, and 70%. A gap of the valve-opening timing of a solenoid valve decreases, so that from drawing 4 and the electromagnetic force of the valve-opening direction by the bias current approaches the clausilium force with a spring. Therefore, if it compares with [refer to drawing 4 (b)] conventionally even when the electromagnetic force of the valve-opening direction by the bias current is smaller than the clausilium force with the spring at the time of clausilium, a gap of valve-opening timing can be lessened and the valve-opening property of the purge control valve 31 can be improved.

[0026] Moreover, at the above-mentioned operation gestalt, the clausilium condition of the purge control valve 31 is fixed time amount Td. While being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of the purge control valve 31 since the bias current of a solenoid coil 40 was turned off by bias current ON / OFF circuit 38 when it continues above, the clausilium force with a spring can be used certainly and the purge control valve 31 can be certainly held in the clausilium condition.

[0027] In addition, although the condition that the bias current was turned off will continue with the above-mentioned operation gestalt until the start / fall edge of the output (signal which reversed the duty signal Duty) of a comparator 35 are detected after that once a bias current is turned off for example, when the bias current is turned off Before outputting the duty signal Duty from the microcomputer in the engine control circuit 32 The pulse for resumption of bias current energization is outputted, and after reversing the output of bias current ON / off circuit 38 high-level and resuming energization of a bias current by this pulse, you may make it output the duty signal Duty.

[0028] Moreover, although diode 52 was used as a means to absorb the surge voltage by the solenoid coil 40, with the above-mentioned operation gestalt, it may replace with this and the surge absorber which used zener diode, a CR circuit, etc. may be used. Moreover, switching elements 42, 47, and 55 may be replaced with MOSFET, and other switching elements, such as a bipolar transistor, IGBT, and a thyristor, may be used for them.

[0029] In addition, this invention is applicable also to the control device of various kinds of solenoid valves which are not limited to the control device of a purge control valve, for example, are used for automobiles, such as an idle speed control valve (ISCV), and various kinds of solenoid valves used in addition to an automobile.

[Translation done.]

*** NOTICES ***

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the solenoid-valve control unit which has improved the valve-opening property of a solenoid valve.

[Translation done.]

*** NOTICES ***

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the solenoid-valve control unit which has improved the valve-opening property of a solenoid valve.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, since the spring which energizes a valve element in the direction of clausilium is built in a purge control valve (solenoid valve) and a clausilium condition is maintained according to this spring force, in order to open, it is necessary to generate at least only the electromagnetic force (valve-opening force) which overcomes the clausilium force with a spring in a solenoid.

[0006] During car operation, since supply voltage is changed or coil resistance changes with change of coil temperature, as the applied voltage to a solenoid shown to drawing 4 (b) in the method which carries out duty control, the current value which flows to a solenoid coil by fluctuation of supply voltage or change of coil temperature will change, the electromagnetic force of a solenoid will change a lot, and the duty signal DUTY in case a purge control valve actually begins to open from a clausilium condition will change a lot.

[0007] In order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, Although it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve, in the conventional duty control system Since the valve-opening timing of a purge control valve shifts greatly by fluctuation of supply voltage, or change of coil temperature as shown in drawing 4 (b), An engine control circuit cannot understand valve-opening timing of an actual purge control valve, and sudden change of the air-fuel ratio by valve opening of a purge control valve cannot be amended with a sufficient precision.

[0008] In order to cancel this fault, there are some which adopted the purge control valve of the current control system which controls electromagnetic force (coil current value) by carrying out feedback control of the current passed to a solenoid coil in recent years not to be influenced [fluctuation of supply voltage or] by coil temperature of change. However, in this current control system, since it is necessary to carry out feedback control of the coil current in all fields, the configuration of a control circuit is complicated and there is a fault which carries out a cost rise.

[0009] This invention is made in consideration of such a situation, therefore the purpose is in offering the solenoid-valve control unit which can reconcile the improvement in the valve-opening control characteristic and low-cost-izing of a solenoid valve.

[Translation done.]

*** NOTICES ***

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the solenoid-valve control device of claim 1 of this invention is passing a predetermined bias current to a solenoid coil by the bias current control means, and generates the electromagnetic force of the valve-opening direction which opposes the clausilium force with a spring. A gap of the valve-opening timing of a solenoid valve decreases, so that the electromagnetic force of the valve-opening direction by this bias current approaches the clausilium force with a spring (refer to drawing 4). Therefore, if duty control is performed for a bias current with a sink, the opening of a solenoid valve is controllable with a sufficient precision from the conventional duty control. And it is not necessary to carry out feedback control of the coil current in all fields, and, unlike a current control system, easy circuitry can be adopted.

[0011] In this case, it is desirable to set up a bias current like claim 2, so that the electromagnetic force of the valve-opening direction by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. If it does in this way, even if there are fluctuation of supply voltage and change of coil temperature, a gap of the valve-opening timing of a solenoid valve can be lost mostly.

[0012] Moreover, when the clausilium condition of a solenoid valve continues beyond predetermined time, you may make it turn off a bias current like claim 3. That is, while being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of a solenoid valve if a bias current is turned off since it is not necessary to pass a bias current when the clausilium condition of a solenoid valve continues for a long time, the clausilium force with a spring can be used certainly and a solenoid valve can be certainly held in the clausilium condition.

[0013] Although the solenoid-valve control unit of this invention explained above can apply the flow of various fluids to the system controlled by the solenoid valve, if it applies to an evaporative gas purge system, big effectiveness will be especially acquired like claim 4. That is, in order for the amount of purges of evaporative gas to increase rapidly and to make an air-fuel ratio change suddenly immediately after valve opening of a purge control valve, it is desirable to amend an air-fuel ratio according to the amount of purges to valve opening and coincidence of a purge control valve. Since a gap of valve-opening timing is few (or zero) as compared with the conventional duty control system, the solenoid-valve control device of this invention becomes possible [amending sudden change of the air-fuel ratio by valve opening of a purge control valve with a sufficient precision], and can improve the emission and drivability at the time of purge control.

[0014]

[Embodiment of the Invention] Hereafter, 1 operation gestalt which applied this invention to the evaporative gas purge system is explained based on a drawing. First, the outline configuration of the whole system is explained based on drawing 3 . An air cleaner 13 is formed in the upstream of the inlet pipe 12 of an engine 11, and the air which passed this air cleaner 13 is inhaled by each gas column of an engine 11 through a throttle valve 14. Moreover, a fuel injection valve 16 is formed in the suction port of each gas column of an inlet pipe 12, and the fuel in a fuel tank 17 (gasoline) is sent to each fuel injection valve 16 through a fuel line 19 by the fuel pump 18.

[0015] Next, the configuration of the evaporative gas purge system 21 is explained. A canister 23 is

connected to a fuel tank 17 through the communicating tube 22, and it is adsorbed by adsorbent 24, such as activated carbon held in this canister 23, in evaporative gas. The atmospheric-air communicating tube 25 which is open for free passage to atmospheric air is formed in the bottom surface part of this canister 23, and the canister lock out valve 26 is attached in this atmospheric-air communicating tube 25. This canister lock out valve 26 is constituted by the solenoid valve of a normally open mold, during purge control, is maintained by the OFF state (valve-opening condition), and is held at the condition that the inside of a canister 23 was wide opened by atmospheric air.

[0016] On the other hand, between a canister 23 and an inlet pipe 12, the purge paths 30a and 30b for purging the evaporative gas with which adsorbent 24 was adsorbed to an inlet pipe 12 (emission) are formed, and the purge control valve 31 which adjusts a purge flow rate between this purge path 30a and 30b is formed in it. This purge control valve 31 is constituted by the solenoid valve of a normally closed mold, and is held in the clausilium condition with the built-in spring (not shown) at the time of OFF. This purge control valve 31 is controlled by the microcomputer (not shown) and the purge control circuit 33 (refer to drawing 1) which were prepared in the engine control circuit 32. The microcomputer in the engine control circuit 32 calculates the target opening (rate of a target purge) of the purge control valve 31 according to an engine operation condition, and outputs the duty signal Duty according to the target opening to the purge control circuit 33.

[0017] Next, the configuration of the purge control circuit 33 is explained based on drawing 1. The comparator 35 is built in the input interface circuitry 34 of the purge control circuit 33. The duty signal Duty outputted from the microcomputer in the engine control circuit 32 is inputted into - input terminal of this comparator 35, and the reference voltage V_{th} by which the partial pressure was carried out by the resistance ratio of the partial pressure circuit 36 is inputted into + input terminal of this comparator 35. The duty signal Duty is compared with reference voltage V_{th} , as shown in drawing 2, when the duty signal Duty is high level ($Duty > V_{th}$), the output of this comparator 35 serves as a low level, and when the duty signal Duty is a low level ($Duty < V_{th}$), it becomes high-level outputting [of this comparator 35] a comparator 35.

[0018] The output (signal which reversed the duty signal Duty) of this comparator 35 is inputted into the duty control circuit 37, the bias current ON / off circuit 38, and the fail-safe circuit 39, respectively. The duty control circuit 37 is a circuit which carries out duty control of the energization to the solenoid coil 40 of the purge control valve 31, and consists of AND circuit 41 and switching elements 42, such as MOSFET driven with the output of this AND circuit 41. The output of a comparator 35 and the output of bias current ON / OFF circuit 38 are inputted into both the input terminals of AND circuit 41, only when both inputs of both are high-level, the output of AND circuit 41 is reversed high-level, and the switching element 42 for duty control turns on. Since this switching element 42 is formed all over the energization circuit of a solenoid coil 40, if a switching element 42 turns on, a current will flow to a solenoid coil 40.

[0019] For bias current ON / off circuit 38, the clausilium condition of the purge control valve 31 is fixed time amount T_d . When it continues above, it is the circuit which turns off the bias current of a solenoid coil 40, and it consists of the edge detectors 43, the timers 44, and carry signal output circuit 45 grades which detect the start of the output of a comparator 35, and the edge of a fall. The edge detector 43 clears a timer 44, when the edge of the start of the output of a comparator 35 and either of the falls is detected. When this timer 44 counts the elapsed time after clear and that counted value reaches fixed time amount T_d (time amount of at least several times or more of the period of the duty signal Duty), That is, the condition (clausilium condition of the purge control valve 31) that the start / fall edge of the output of a comparator 35 are not detected is fixed time amount T_d . When it reaches A carry signal is outputted from the carry signal output circuit 45, and the output of bias current ON / off circuit 38 is reversed to a low level with this carry signal. This low-level signal is inputted into the duty control circuit 37 and the bias current control circuit 46 mentioned later, respectively, and will be in the condition that actuation of both sides was forbidden. Thereby, the bias current of a solenoid coil 40 is turned off.

[0020] If the edge of the start of the output of a comparator 35 and either of the falls is detected after [of

a bias current] off, and in the edge detector 43, at the time, the output of bias current ON / off circuit 38 is reversed high-level, and it will be in the condition that actuation of the duty control circuit 37 and the bias current control circuit 46 was permitted. Thereby, a bias current flows again to a solenoid coil 40. [0021] The bias current control circuit 46 is a circuit which passes a fixed bias current to a solenoid coil 40, and is established in the switching element 42 for duty control and juxtaposition which the series circuit of the switching elements 47, such as MOSFET which controls a bias current, and the current detection resistance 48 mentioned above. The bias current which flows to a solenoid coil 40 flows to the current detection resistance 48 through the switching element 47 for bias current control, and the electrical potential difference V_{bias} according to a bias current generates it in this current detection resistance 48. This electrical potential difference V_{bias} is the reference voltage V_{ref} for a bias current setup by which was inputted into - input terminal of a comparator 50, and the partial pressure was carried out to + input terminal of this comparator 50 by the resistance ratio of the partial pressure circuit 51. It is inputted. A comparator 50 is the bias current detection electrical potential difference V_{bias} and reference voltage V_{ref} . It compares and an output is switched to high level/low level according to the comparison result. The output of this comparator 50 is inputted into one input terminal of AND circuit 49, and the output of bias current ON / off circuit 38 is inputted into the input terminal of another side of this AND circuit 49. With the output of this AND circuit 49, a switching element 47 drives and a fixed bias current is passed by the solenoid coil 40.

[0022] During duty control (under purge control), since one input (output of bias current ON / off circuit 38) of AND circuit 49 is maintained high-level, the output level of AND circuit 49 is switched according to the output of the comparator 50 inputted into the input terminal of another side. Thereby, the bias current which flows to a solenoid coil 40 is reference voltage V_{ref} . ON/OFF of the switching element 47 for bias current control are controlled to become the set-up desired value. In this case, the desired value (reference voltage V_{ref}) of a bias current is set up so that the electromagnetic force of the valve-opening direction of the purge control valve 31 by the bias current may cancel mostly the clausilium force with the spring at the time of clausilium. The bias current control circuit 46, and the bias current ON / off circuit 38 explained above functions as a bias current control means as used in the field of a claim.

[0023] On the other hand, the fail-safe circuit 39 consists of a malfunction detection circuit 53 which detects the abnormalities of the purge control circuit 33, a charge pump 54 which carries out the pressure up of the supply voltage (+B), and switching elements 55, such as MOSFET driven with this charge pump 54, and the switching element 55 is connected all over the energization circuit of a solenoid coil 40. While the purge control circuit 33 is operating normally, a driving signal is outputted to the charge pump 54 from the malfunction detection circuit 53, the charge pump 54 drives, and a switching element 55 is held at an ON state. And if the malfunction detection circuit 53 detects the abnormalities of the purge control circuit 33, the drive of the charge pump 54 will be stopped, a switching element 55 will turn off, and the energization to a solenoid coil 40 will be intercepted. In addition, the diode 52 for surge absorption is connected to the solenoid coil 40 at juxtaposition.

[0024] With the operation gestalt explained above, while passing a fixed bias current to the solenoid coil 40 of the purge control valve 31 by the bias current control circuit 46 Since a bias current is controlled so that the electromagnetic force of the valve-opening direction by the bias current cancels mostly the clausilium force with the spring at the time of clausilium As shown in drawing 4 (a), even if electromagnetic force (valve-opening force) changes with fluctuation of supply voltage, or change of coil temperature, a gap of the valve-opening timing of the purge control valve 31 can be lost mostly. For this reason, even if it judges the valve-opening timing of the purge control valve 31 from the duty signal Duty and amends fluctuation of the air-fuel ratio by purge control, it becomes possible to perform this air-fuel ratio amendment with a precision more sufficient than [referring to drawing 4 (b)] conventionally, and the emission and drivability at the time of purge control can be improved. And it is not necessary to carry out feedback control of the coil current in all fields, unlike a current control system, easy circuitry can be adopted, and the demand of low-cost-izing can be filled.

[0025] In addition, although it set up with the above-mentioned operation gestalt so that the

electromagnetic force of the valve-opening direction by the bias current might cancel mostly the clausilium force with the spring at the time of clausilium, the electromagnetic force of the valve-opening direction by the bias current may be set as either, such as --, the clausilium force with the spring at the time of clausilium, for example, 90%, 80%, and 70%. A gap of the valve-opening timing of a solenoid valve decreases, so that from drawing 4 and the electromagnetic force of the valve-opening direction by the bias current approaches the clausilium force with a spring. Therefore, if it compares with [refer to drawing 4 (b)] conventionally even when the electromagnetic force of the valve-opening direction by the bias current is smaller than the clausilium force with the spring at the time of clausilium, a gap of valve-opening timing can be lessened and the valve-opening property of the purge control valve 31 can be improved.

[0026] Moreover, at the above-mentioned operation gestalt, the clausilium condition of the purge control valve 31 is fixed time amount T_d . While being able to avoid the increment in power consumption and coil temperature rise by the bias current in the clausilium of the purge control valve 31 since the bias current of a solenoid coil 40 was turned off by bias current ON / OFF circuit 38 when it continues above, the clausilium force with a spring can be used certainly and the purge control valve 31 can be certainly held in the clausilium condition.

[0027] In addition, although the condition that the bias current was turned off will continue with the above-mentioned operation gestalt until the start / fall edge of the output (signal which reversed the duty signal Duty) of a comparator 35 are detected after that once a bias current is turned off for example, when the bias current is turned off Before outputting the duty signal Duty from the microcomputer in the engine control circuit 32 The pulse for resumption of bias current energization is outputted, and after reversing the output of bias current ON / off circuit 38 high-level and resuming energization of a bias current by this pulse, you may make it output the duty signal Duty.

[0028] Moreover, although diode 52 was used as a means to absorb the surge voltage by the solenoid coil 40, with the above-mentioned operation gestalt, it may replace with this and the surge absorber which used zener diode, a CR circuit, etc. may be used. Moreover, switching elements 42, 47, and 55 may be replaced with MOSFET, and other switching elements, such as a bipolar transistor, IGBT, and a thyristor, may be used for them.

[0029] In addition, this invention is applicable also to the control device of various kinds of solenoid valves which are not limited to the control device of a purge control valve, for example, are used for automobiles, such as an idle speed control valve (ISCV), and various kinds of solenoid valves used in addition to an automobile.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The circuit diagram showing the configuration of the purge control circuit in 1 operation gestalt which applied this invention to the evaporative gas purge system

[Drawing 2] The timing diagram which shows the voltage waveform of each part of a purge control circuit

[Drawing 3] Drawing showing roughly the evaporative gas purge structure of a system

[Drawing 4] For (a), (b) is drawing showing the valve-opening property of the purge control valve in the operation gestalt of this invention, and drawing showing the valve-opening property of the conventional purge control valve.

[Description of Notations]

12 -- An inlet pipe, 17 -- A fuel tank, 21 -- Evaporative gas purge system, 23 [-- Purge path,] -- A canister, 24 -- Adsorbent, 26 -- A canister lock out valve, 30a, 30b 31 -- A purge control valve (solenoid valve), 32 -- An engine control circuit, 33 -- Purge control circuit, 37 -- A duty control circuit, 38 -- Bias current ON / off circuit (bias current control means), 39 [-- A bias current control circuit (bias current control means), 47 / -- A switching element, 48 / -- Current detection resistance, 53 / -- A malfunction detection circuit, 55 / -- Switching element.] -- A fail-safe circuit, 40 -- A solenoid coil, 42 -- A switching element, 46

[Translation done.]

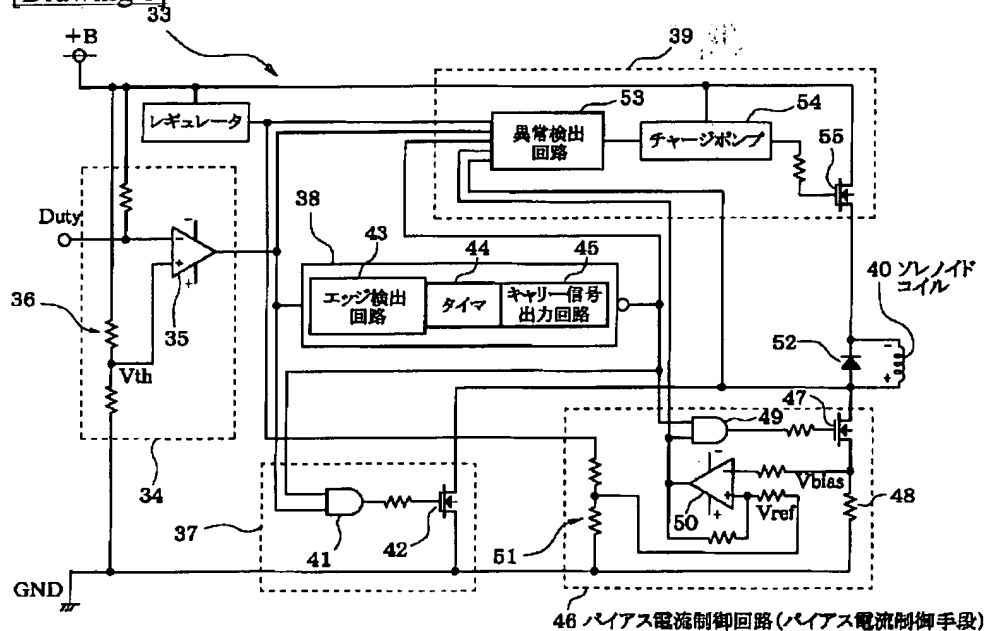
* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

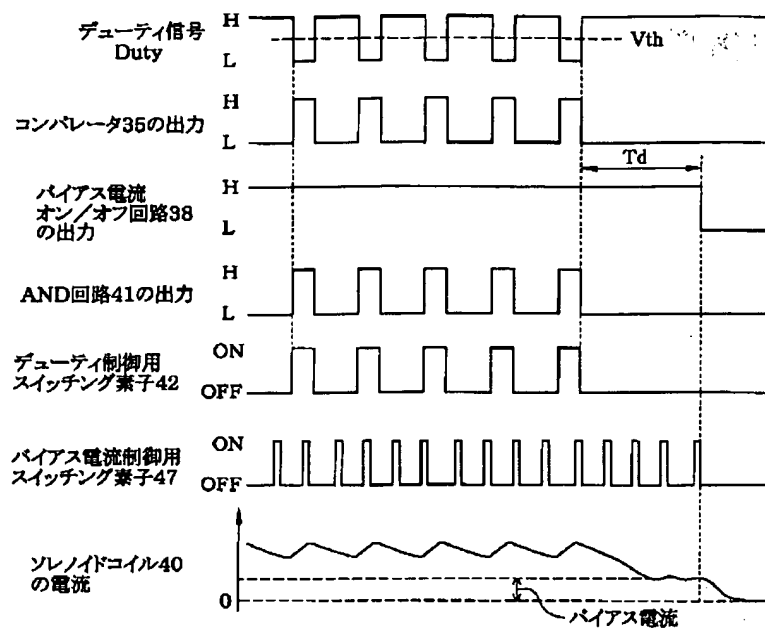
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

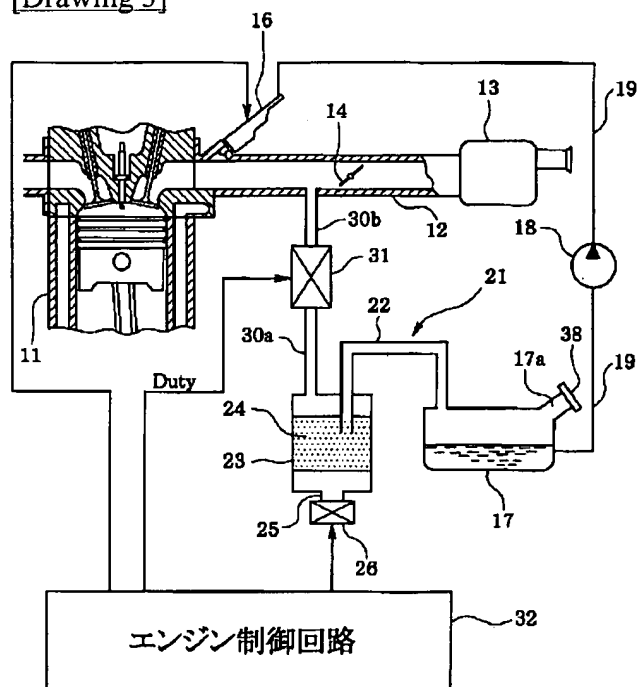
[Drawing 1]



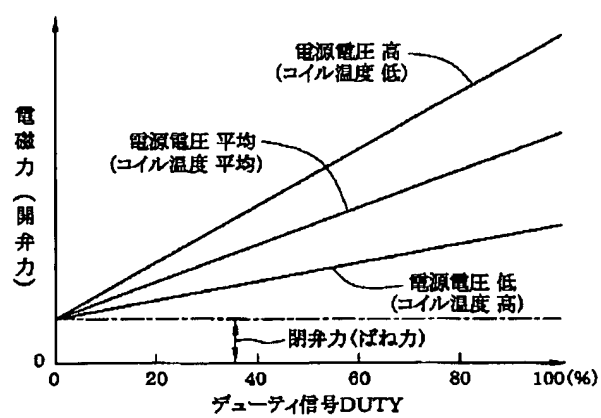
[Drawing 2]



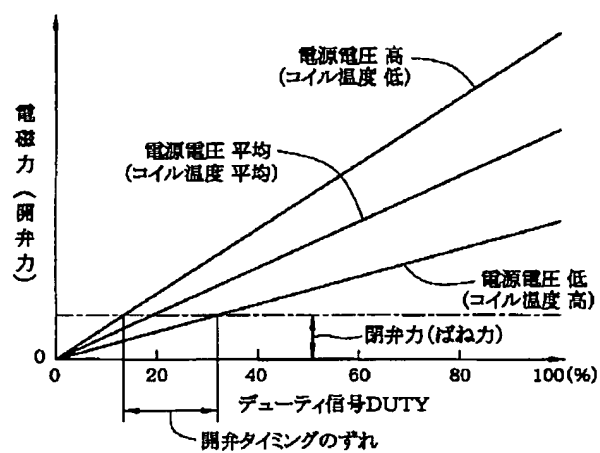
[Drawing 3]



[Drawing 4]



(a) 本発明の実施形態



(b) 従来のデューティ制御

[Translation done.]